THE BABINSKI REFLEX.[1]

By C. Van Epps, M.D.

I owe the opportunity to make the following study to my chiefs at the Philadelphia Hospital, Drs. Mills, Dercum, Lloyd and Burr, and to the chief resident physician, Dr. Daniel E. Hughes. The purpose of my investigation was to determine the conditions in which the Babinski reflex is present. The data consisted of one thousand persons classified as follows:—

Babies and children	100
Patients in medical wards presenting no nervous symptoms	165
Insane patients presenting no organic cerebrospinal disease	335
Patients suffering from nervous disease but presenting no symptoms of involvement of the lateral tracts	213
Hemiplegics and diplegics	125
Patients having disease of the spinal cord with manifest involvement of the lateral tracts.	62

In health on stroking the sole there follows flexion of the toes with or without movement of the ankle and leg. This reflex is not present in every one, some normal persons having no plantar reflex at all.

Babinski discovered that in certain diseases the plantar reflex is altered and claimed that this alteration is constantly present whenever there is "perturbation" of the lateral tracts. He described the alteration as follows: There is extension of the great toe with or without extension and separation of the other toes, the movement being slower than the normal reflex and more readily produced by stroking the outer than the inner side of the sole.

In testing for the reflex I used, as a rule, an ordinary blunt tooth-pick; if the sole was very sensitive I used my finger tips, and if very strong irritation was necessary, I used the blunt point of a small metal bar. Usually extension when present was best produced by stroking the outer side of the sole in a forward direction. Less often transverse stroking of the sole was more efficient. When flexion was present, stroking the inner side of the sole usually produced the best reflex.

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[1] Read before the Philadelphia Neurological Society, October 22, 1900.

I have found that there is a great variation in the number of toes which extend, and that sometimes there is flexion of some of the smaller toes and extension of the others, including always the big toe, which is never flexed. For example, in sixty-eight hemiplegics the following manifestations of the Babinski reflex were found:—

Extension of all the the toes, big toe most	50%.
Extension of the big toe, small toes flexed	27%.
Extension of big toe, no motion small toes	22%.
Extension of small toes only	1%.
Extension of all toes, small toes most	0%.

THE NORMAL PLANTAR REFLEX IN ADULTS.

To determine the normal plantar reflex I examined five hundred patients from the General Hospital and the Insane Department. None of these patients had any symptoms of organic cerebro-spinal disease. In this group I found the plantar reflex absent on both sides 19 cases, or only 3.8 per cent., and absent in one side only in 11 cases, or 2.2 per cent. These figures are much smaller than those of most investigators, many reporting an absence of motion in both feet in 10 per cent. and in one foot only in 15 per cent. On the other hand Collier[2] states, "It is doubtful whether the plantar reflex is ever constantly and completely absent in healthy subjects." This may be explained by the fact that he has considered as a part of the normal plantar reflex contraction of the thigh muscles, especially the tensor-vaginae-femoris. Considered thus I found complete and constant absence of all reflex motion in only one case or in one-fifth of one per cent.

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[2] Brain, Spring, 1899.

In one case there was constant extension of all the toes in one foot; in five cases irregular flexion and extension occurred in all the toes of one or both feet; or in all extension in some form was present in seven cases, or ¼ per cent., and in only one case was a typical Babinski reflex found in both feet. The history of this case I now give in detail:

G. E., male, German, laborer, married, entered hospital 9, 6, 1900, complaining of cough and abdominal pain. No history of syphilis, typical history of phthisis for three years past; tubercle bacilli were found and patient was sent to phthisis ward where malarial paroxysms developed.

Examination showed a fairly well nourished muscular German of about 45 years; memory and speech fair; the pupils were equal 2.5 mm., reacted well to light, in accommodation and convergence; there was no extra-ocular defect; the vision of each eye was normal; the ophthalmoscopic examination was negative. The tongue was straight, dry, gray coated and showed no tremor; the pulse was normal; the heart showed no gross lesion; the lungs showed cavity at the right apex and involvement of the left apex; the abdomen was slightly tense and tender; the spine was straight, with no prominences, or tenderness. The extremities were muscular and the gross strength was normal; there were no tremors or ataxia; the station and gait were good, and sensation was normal. Reflexes: there was no jaw-jerk, the biceps-jerks and knee-jerks were equal and quick; there was no ankle or patellar clonus. Stroking the right sole caused active extension of all the toes, especially the big toe, while stroking the left sole caused active extension of the big toe with indefinite extension and flexion of the smaller toes. With the exception of two tests made during the height of the second febrile paroxysm in which the toes were usually flexed, the patient has always shown a typical Babinski reflex in both feet. During other febrile paroxysms extension was continually present, proving that the temperature and the slight delirium present each time bore no relation to the form of plantar reflex. Over a one and one-half hour period with a temperature of 95.8 degrees, marked jaw-jerk, spinal epilepsy, spastic knee-jerks, ankle and patellar clonus were present.

In this case the complete absence of history and physical signs of organic nervous lesion make us consider whether the typical Babinski reflex may not occur with a normal spinal cord. Dr. Burr tells me that he has rarely found constantly present ankle-clonus and exaggerated knee-jerk in phthisis without other signs of cord diseases. These two symptoms have been practically absent in this case, therefore we have to do either with a case in which there is present some tubercular process involving directly or indirectly the spinal cord, and in which there is no other clinical evidence of such a process than the Babinski reflex, or else with an anatomically normal spinal cord showing an anomalous plantar reflex.

THE NORMAL PLANTAR REFLEX IN CHILDREN.

It is difficult to determine what constitutes the plantar reflex in children under one year old because, without any external stimulus, their toes and feet are almost always in movement. I have examined the same babies on different days, usually with contrary results, and I have observed the same fact in comparing my notes with those of Dr. Burr in cases examined by him the same day. One baby two weeks old, examined while asleep, showed a typical extension of all the toes as found in the adult. Another baby, also asleep, showed usually typical adult extension. The following percentages are those obtained from tests on fifty babies under one year old:—

Extension usually of all toes	50%.
Flexion, usually of all toes	20%.
Irregular flexion and extension	20%.
Feet held too stiffly to obtain reflex	8%.
Absence of motion	2%.

In fifty healthy children between one and twelve years of age,, typical extension was never found constantly present; in two cases, one of sixteen months and the other two years, extension usually occurred in both feet. In four cases, two of eighteen months, one of two years, and one six years, there was irregular flexion and extension. With the exception of this last case neither typical nor irregular extension was observed in children over two years old examined while awake. One child of six years, who when awake had active flexion of all the toes in both feet, when asleep showed constant moderate extension of the small toes and doubtful extension of the big toes in response to irritation of the sole or any part of the leg or thigh. In three other children flexion was equally or more pronounced during sleep.

NERVOUS DISEASES WITH NO MANIFEST DISORDER OF PYRAMIDAL TRACTS.

Of the 213 cases of disease of the nervous system with no demonstrable lesions of the pyramidal tract and under which are included tabes dorsalis, Friedreich's ataxia, paralysis agitans, progressive muscular atrophy, multiple neuritis, epilepsy, imbecility, primary neuritic atrophy, chronic chorea, hydrocephalus, monoplegia, cerebral tumors, cerebellar tumor, brachial neuritis, lead palsy, post-diphtheritic paralysis, neurasthenia, senility, uremia, Raynaud's disease, cerebro-spinal syphilis, cerebral syphilis, toxic ataxias, exophthalmic goiter, and hysteria, flexion was present in 167 cases, or 78 per cent. In 38 cases or 18% there was no motion. In 5 cases there was constant extension in both feet; in one constant extension in one foot and in two irregular flexion and extension in both feet. Of the five cases with constant extension, four were tabetic and one neurasthenic with the following histories:—

Case I.—Tabes, W. B., 49 years old, moulder, white, admitted to nervous wards 12, 6, '98, complaining of weakness in legs. He gave a history of constant pain in head with increasing deafness for ten years past. Four years ago he developed pain and dragging of left leg and shortly afterwards of the right leg. Three years before he suffered from a transient diplopia and afterwards from girdle pains, acute retention of urine and obstinate constipation. Entrance examination showed a white male, very deaf, with Argyll-Robertson pupils, ataxia of arms, station and gait; absence of knee-jerks and plantar reflex, and normal sensation. Since then there is a record of repeated attacks of acute retention of urine, of trophic ulcers on feet, and of increasing ataxia. Upon my examination of him in February, 1900, he complained of constant pain in the head. He was very deaf, apparently demented, almost helpless from ataxia. Argyll-Robertson pupils were present, and the knee-jerks were absent. On the right side, stroking the sole produced constant weak extension of all the toes, on the left, stroking the sole caused irregular flexion and extension of all the toes. Six weeks later extension was constant in the first, second and third toes of both feet. The patient now failed more rapidly mentally and physically, and for two weeks before death had marked extension of all toes in both feet.

Case II.—Tabes, W. S., 21 years old, male, white, admitted to nervous wards, 6, 8, '98, complaining of pains in head and of "nervous spells," No venereal history. Could not walk until three years old and his legs were always weak. One year ago he began to notice failing vision and shooting pains in legs. Entrance examination showed a moderately well nourished white man about 21 years old; facial expression dull. Eyes: pupils large, unequal, no light reaction, feeble response in accommodation, slight nystagmus on fixation, extra-ocular motion fair, simple atrophy of both optic nerves. The tongue was flat, flabby and slightly tremulous. The knee-jerks were absent on both sides, and there was no ankle-clonus; moderate ataxia of station and gait; sensation delayed to touch and pain tests over arms and legs. After repeated attacks of laryngeal crises, and on account of dementia, he was transferred to the insane department. Examination February, 1900, showed patient, blind, bed-ridden, demented, Argyll-Robertson pupils, knee-jerks absent. On stroking the soles, active extension of all the toes, most marked in the big toes, was produced in both feet.

Case III.—Tabes, L. S., male, white, 62 years old, admitted to nervous ward 5, 23, '96. Two years before admission developed shooting pains in legs and bad feeling around the waist, and later vertigo. Entance examination revealed a very deaf, poorly nourished German of about 65 years, with Argyll-Robertson pupils, absent knee-jerks, ataxia of arms, station and gait, and some hyperesthesia of legs. On examination 9, 24, 1900, patient complained of pain in legs and attacks of vomiting. He was very deaf, and apparently demented; speech was feeble, slow and indistinct; Argyll-Robertson pupils were present; there was moderate ataxia of arms, station and gait; the biceps-jerks were active, and the knee-jerks were absent; plantar irritation on the right side caused active but limited extension of big toes with no motion in small toes. On the left there was marked extension of the big toe with indefinite flexion of small toes.

Case IV.—Tabes, M. F., 55 years old, male, white, admitted to nervous ward, 11, 11, '98, complaining of pain in left side and back. He has since shown constantly moderate ataxia of arms, station and gait, Argyll-Robertson pupils, absent knee-jerk, and has complained much of pain in left side and shooting pains in legs. Recent examination showed a fair mental condition, slight tremor of the tongue and hands and repeated tests have shown extension of the big toes with no motion of the small toes in both feet.

In the cases of tabes examined by Babinski, van Gehuchten and Collier the extensor response was never met with. Babinski[3] reports a case of tabes combined with paresis in which there was typical extension in both feet. Three combined tabes paresis cases in my own series showed no plantar reflex. Three of the tabes cases above mentioned in detail were undoubtedly with dementia, yet this fact alone does not seem a sufficient explanation for the presence of the Babinski phenomenon, because in 72 cases of dementia and 28 cases of paresis the extensor phenomenon was never present.

Case V.—Neurasthenia, O. N., male, white, 62 years old, admitted to nervous wards 12, 14, '99, complaining of general weakness. Examination showed memory, speech, eyes, station, gait and gross strength normal; the knee-jerks were weak. Plantar irritation caused active extension and separation of the small toes on the right; on the left there was moderate extension of the large toe and indefinite extension of the small toes. Repeated and recent examinations confirm the above statement.

Case VI.—Multiple alcoholic neuritis, O. L., male, white, 43 years old; examination showed eyes normal, limbs much emaciated, marked diminution of pain and thermal sense over limbs and anterior part of the body, knee-jerks absent. On the right, stroking the sole caused good plantar flexion; on the left, there was usually slight extension of all the toes, never flexion.

In 85 epileptic cases flexion was present in 83. In two there was no motion. In a number of examinations made during and after a convulsion, but while coma was present, flexion was present in all as soon as the spasm had relaxed, except in the following case:—

W. W., male, white, 64 years old; history of twelve epileptoid convulsions during past four years. Examination showed feeble-minded, passive, well-nourished male of about 65 years; gross strength normal, reflexes active throughout; station, gait, sensation fair. Plantar irritation caused fair flexion of all the toes on both feet; no symptoms of cerebral tumor. The patient was found unconscious with stertorous breathing by the nurse; ten minutes later, when I saw him, he was still unconscious, the head was retracted, the limbs were rather stiff, the biceps- and knee-jerks were active, no ankle or patellar clonus. Plantar irritation caused active extension of the big toes with no motion in small toes on either side. Seven minutes later he developed flexion of all the toes of right foot, and twenty-five minutes later, absence of motion or indefinite flexion in the left foot. The knee-jerks were slightly increased during the attack. The following day plantar irritation caused good flexion of all toes on both feet. Dr. H. O. Shiffert, a Blockley colleague tells me that in one patient during an uremic convulsion he obtained typical extension of all the toes on both feet. Later I examined the same patient while in a state of coma and found normal flexion in both feet. I have examined seven uremic cases in the state of coma. In six flexion was present and in one there was no plantar reflex.

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[3] La Semaine Médicale, July 27, 1898.

HEMIPLEGICS AND DIPLEGICS.

In 118 hemiplegics, extension was present on the paralyzed side in 57 per cent.; flexion of all the toes in 26 per cent.; flexion only of the small toes, 4 per cent.; irregular flexion and extension, 5 per cent.; no motion, 8 per cent. On the opposite side extension was present in 9 per cent.; flexion of all the toes in 72 per cent.; flexion of the small toes, no motion in the big toes, in 4 per cent.; irregular flexion and extension in five per cent.; no motion in 10 per cent.

The duration of the hemiplegia varied from six hours to thirty-nine years, and, apparently, bore no direct relation to the time of appearance or the form of the Babinski reflex.

Case I.—L. B., male, black, 45 years old, history of complete hemiplegia of six hours' duration. On admission there was spastic knee-jerk and absence of plantar reflex on paralyzed side. These conditions remained the same until six weeks later. Fourteen weeks later I again saw the patient, and at that time the knee-jerk was weak, and stroking the sole caused moderate, slow extension of all the toes on the paralyzed side.

Case II.—M. S., white, female, 43 years old; two weeks before admission developed partial paralysis of right face. Twelve hours before admission, patient was found unconscious with stertorous breathing, difficult deglutition, and loss of power in right arm with temperature, pulse and respiration respectively of 102,80 and 32. Admission examination showed a well-nourished white woman, unable to talk but conscious of all that was said; there was some drooping of right face; the eyes showed no deviation, paresis, ataxia, or nystagmus; right hemianopsia was probably present; the tongue was moist, clean, and lay motionless in the floor of mouth; the pulse was 72, full and regular; the heart sounds were obscured by noise of breathing; the lungs were resonant; the breathing was vesicular accompanied by large, moist râles; the abdomen showed nothing abnormal. The extremities were rather rigid, especially the right arm in which no motion, except slight flexion of fingers, was possible; the other limbs were well moved. The reflexes were all spastic; there was patellar clonus on both sides; the ankles were stiffened by old joint lesions and showed no clonus. There was normal plantar flexion in both feet. Sensation was normal; there was urinary and fecal incontinence. Thirty-six hours after stroke the reflexes were no longer spastic, though large; and there was no clonus. Plantar irritation caused the extension of all the toes on the right and flexion of all the toes on the left. Forty-eight hours after the stroke the right leg was flaccid and powerless; the knee-jerks were absent, extension persisted on the right and flexion on the left. Sixty-seven hours after the stroke the knee-jerks were still absent, extension was present in both feet, more marked in right. Until death, which occurred four days later, the knee-jerks remained absent, extension of all the toes persisted in both feet, and the paralysis remained limited to the right side of body, limbs and face. The urinary examinations were always negative. Post-mortem revealed: Marked congestion of cerebral meninges, unusual amount of clear fluid in the ventricles, small area of softening the size of a hickory nut in the right optic thalamus; kidneys show no gross lesion.

Case III.—M. J., female, white, 62 years old, always healthy. The day before admission suddenly developed double vision and a sense of nausea. Entered hospital with incomplete external and internal ophthalmoplegia. The gait and station were poor, the patient falling always toward the left if not supported; there were marked jaw-jerk, biceps-jerk, and knee-jerk. Plantar irritation caused extension of all toes on both feet. Three weeks later complete right hemiplegia developed, but caused no change in the reflexes described above when the patient was examined five days later. In seven diplegics, extension was present in both feet in three cases, irregular flexion in three cases, and week flexion in one.

THE PLANTAR REFLEX IN SPINAL CORD DISEASE WITH LATERAL TRACT INVOLVEMENT.

In this series are cases of spinal syphilis, cerebral-spinal syphilis, myelitis, compression myelitis, traumatic myelitis, syringomyelia, multiple sclerosis, amyotrophic lateral sclerosis, diffuse spinal sclerosis, ataxic paraplegia, spastic paraplegia, spastic monoplegia, meningo-myelitis, and infantile paraplegia.

In the 62 cases of this class, extension was present in 63 per cent.; flexion in 26 per cent.; no motion in 11 per cent.

The following is a case, physiologically at least, of total transverse lesion of the spinal cord.

M. M., 45 years old, female, white, was admitted complaining of loss of power in legs. Six months ago was operated on for carcinoma of the breast of eighteen months' duration; noted return of nodules in scar two weeks ago. Ten days before entrance she developed paresthesia, shooting pains, some loss of sensation and weakness in legs; three days before admission she developed complete paraplegia and loss of sensation in the legs, with incontinence of urine and feces. Examination showed moderately emaciated white female of about 50 years of age; the eyes were normal, and the heart, lung and abdomen showed no gross lesion. There was a small hard nodule in the cicatrix of excision of left breast, and a few hard bodies could be felt in left axilla; there was some prominence of the seventh, eighth and ninth dorsal vertebrae. The extremities were much emaciated; the reflexes of the arms were active; the legs were completely paraplegic, and there was complete loss of sensation over legs and on body up to one inch above umbilicus; the knee-jerks were absent; the sphincters were completely incontinent. Stroking the soles, or irritation of any part of the legs, produced usually, quick flexion of legs and thighs, associated with dorsal flexion of the ankles and irregular extension of the big toes, more marked on the left.

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